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## Bacterial Contamination of Mobile Phones Used by Healthcare Workers: An Unseen Risk.

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### ABSTRACT

Mobile phones have become an essential tool in healthcare settings, but they can harbor microorganisms and contribute to hospital-acquired infections (HAIs). This study investigates the microbial contamination of mobile phones used by healthcare workers (HCWs). The present study was conducted at a tertiary care hospital in Pune, from 1<sup>st</sup> November to 31<sup>st</sup> December 2023. It included 120 HCWs. A self-administered questionnaire was used to gather data on mobile phone usage in hospitals and disinfection practices. Paired samples were collected from the HCWs mobile phones before and after disinfection with disinfectant wipes. Microbiological analysis was performed to identify bacterial contamination and assess the effectiveness of disinfection. Analysis of the questionnaire data revealed that 96.67% of participants used smartphones for communication in hospitals, with 90% participants disinfecting their devices rarely. All participants (100%) acknowledged the need for mobile disinfection guidelines in healthcare settings. Microbiological analysis of mobile phone swabs showed that 65.8% of mobile phones were contaminated prior to disinfection. Gram- positive bacilli (49.4%) were the most common organism isolated, followed by Coagulase Negative *Staphylococcus* (24.1%) and *Staphylococcus aureus* (22.8%). Disinfection effectively eliminated bacterial growth, showing a statistically significant reduction in colony counts ( $p \leq 0.001$ ). This study underscores the high prevalence of microbial contamination on mobile phones used by HCWs and confirms the effectiveness of disinfectant wipes in reducing bacterial contamination. Establishing standardized disinfection guidelines is crucial to mitigate contamination risks and ensure patient safety.

**Keywords:** mobile phones, healthcare workers, microbial contamination, disinfection, hospital- acquired infections, infection control.

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## INTRODUCTION

Mobile phones have become essential in both personal and professional life, including modern healthcare, where they offer vast opportunities to improve communication, efficiency, and quality of care. These compact electronic devices have replaced landline telephones, providing the ability to connect globally from any location at any time [1, 2]. By leveraging mobile technology in responsible and innovative ways, healthcare workers (HCWs) can effectively manage the intricacies of healthcare delivery, improve patient outcomes, and contribute to the future of medicine. Approximately 98% of HCWs own a mobile phone, and about 84% of them carry it to their workplace [3]. HCWs carry their phones throughout the hospital areas, from patient bedsides – where they may use it to record patient data – to dining areas for browsing both personal and professional information. These devices frequently come in contact with the user's face, ears, hands, and various surfaces. Microorganisms inhabit both animate and inanimate objects, and mobile phones are no exception to this rule [4, 5]. Mobile phones can harbor microorganisms for weeks, as the warmth and humidity of the device create ideal conditions for these microbes to thrive [6]. In healthcare settings, HCWs become potential vectors for transmitting both transient pathogenic bacteria and resident flora from one patient to another. This is primarily due to inadequate device disinfection and hand hygiene practices, thus contributing to the spread of hospital-acquired infections (HAIs) [7-9].

Multiple studies have identified both resident and transient microorganisms on mobile phones, including Coagulase Negative *Staphylococcus* species (CoNS), *Staphylococcus aureus*, *Klebsiella* species, *Pseudomonas* species, *Escherichia coli*, *Acinetobacter* species. Some of these organisms exhibit multidrug resistance [10-12]. Studies have also isolated Methicillin Resistant *Staphylococcus aureus* (MRSA), Extended Spectrum Beta-lactamase (ESBL) *Enterobacteriaceae*, and pathogens resistant to aminoglycosides and carbapenems [13-15]. Most HCWs are unaware of the potential risk these devices pose. They may act as vectors for transmitting multi-drug resistant (MDR) pathogens, which may spread from hospitals to the community [16]. Therefore, we aim to investigate the microbial contamination on mobile phones of HCWs in our tertiary care hospital. This could help in the development of disinfection policies for mobile phones in healthcare settings, thereby reducing the burden of HAIs.

## MATERIAL AND METHODS

### Study Design

This study was conducted by Department of Microbiology at BJ Government Medical college and Sassoon General Hospitals, Pune, Maharashtra. The study was approved by the Institutional Ethics Committee. Samples were collected between 1<sup>st</sup> November 2023 to 31<sup>st</sup> December 2023 using convenient sampling method. In total, 120 paired samples were collected from the mobile phones of HCWs, both before and after they were disinfected with Hydrogen peroxide and Peracetic acid disinfectant wipes (BS-Peroxy™ wet wipes, Zuverlasse Hygeine India Pvt. Ltd.). Informed consent was obtained from all participants after they were briefed about the purpose of the study. The anonymity of the participants was protected by using numbers instead of their names.

### Data and Sample Collection

A self-administered questionnaire was used to collect data on mobile phone use related practices (Annexure 1). Following the completion of the questionnaire, the phones were swabbed using a dry, sterile cotton swab, moistened with 5% sterile sodium chloride solution. Before collection, both the hands of the swab collector were cleaned, and sterile disposable gloves were worn (before collection of each sample) throughout the procedure to avoid cross-contamination. The swabs were rolled on the upper, lower, and the side surfaces of the mobilephone, focusing on common areas most often in contact with the user, and the surface where the phone typically rests. Subsequently, the phone was sanitized using disinfectant wet wipes for a contact time of one minute. To evaluate the effectiveness of the disinfection, a second swab was taken from the same areas on the phone post-disinfection. Samples were immediately transported to the laboratory (within an hour) for further processing.

### Microbiological analysis

The swabs were immediately plated onto sheep blood agar and incubated at 37°C for 24-48

hours. Following incubation, the culture plates were examined for different types of bacterial growth and colony forming units (CFUs). Bacterial identification was carried out using standard bacteriological methods.

**Data Analysis**

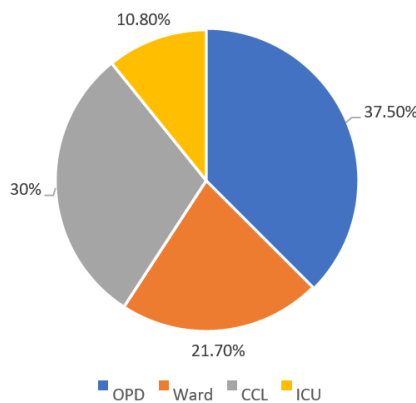
Data was entered and analyzed using Microsoft Excel. Qualitative data was expressed in numbers and percentages. For quantitative data, the paired Student's t-test was used to compare the two means. A p-value  $\leq 0.05$  indicated a statistically significant correlation between the two variables compared in the study.

**RESULTS**

**Demographic Characteristics of Study Participants**

A total of 120 participants were enrolled in the study, of which 78 (65%) were females and 42 (35%) were males. The participants included were from a diverse range of work environments with most of them being doctors working in outpatient departments (OPD) (45/120, 37.5%), followed by in Central Clinical Laboratory (CCL) (36/120, 30%), in wards (26/120, 21.7%), and in Intensive Care Units (ICU) (13/120, 10.8%) (Figure 1).

**Figure 1: Distribution of study population across different work environments**



**Characteristics on the Use of Mobile Phones Among Health Care Workers**

In this study, 96.67% (116 out of 120) of participants used smartphones with large screens, whereas a mere 3.33% (4 out of 120) relied on hospital intercoms for communication during work hours. Among the smartphone users, 95% (114 out of 120) had tempered glass protection on their devices. All participants (100%) considered mobile phones indispensable at work, with 76.67% (92 out of 120) frequently using them during work hours and 23.33% (28 out of 120) using them occasionally. Despite unanimous agreement (100%) that mobile phones can carry microorganisms and contribute to HAIs, none of the participants followed any specific guidelines for mobile use in clinical settings. Mobile cleaning practices were infrequent, with 90% (108 out of 120) seldom cleaning or disinfecting their phones, 7.5% (9 out of 120) cleaning weekly, and only 2.5% (3 out of 120) cleaning their phones after every patient contact. Regarding methods of cleaning, 61.67% (74 out of 120) used wet tissues, 30% (36 out of 120) used dry lint cloths, and 8.33% (10 out of 120) used disinfectant sprays. While none (100%) were aware of any recommendations for cleaning mobile phones, there was a consensus (100%) on the need for policies regarding the use of mobile phones during work hours in hospitals.

**Results of Microbiological Analysis**

On culture, out of 120 swabs, 41 (34.2%) showed no growth. Among the remaining 77 (64.2%), 41 (53.3%) swabs showed  $10^5$  colony forming units (CFUs), and 36 (46.7%) exhibited  $10^3$  CFUs. Mobile contamination was most common among HCWs working in OPDs (73.3%), followed by those in wards (73.1%), ICUs (61.5%), and CCL (52.8%) (Table 1).

Among the contaminated mobile phones, the most common organisms isolated were Gram positive bacilli (GPB) (39/79, 49.4%), followed by Coagulase-Negative *Staphylococci* (CoNS)(19/79, 24%), *Staphylococcus aureus* (18/79, 22.8%), and *Acinetobacter* species (4/79, 5.1%). Table 2 describes the microbial contamination of mobile phones in various work areas. However, no significant statistical relationship was found between the work areas and colony counts (p = 0.502). The culture of post-disinfection swabs showed no growth. A paired Student's t-test compared the colony counts before and after disinfection, indicating a statistically significant difference with a mean of 0.642, a standard deviation of 0.482, and a p-value of  $\leq 0.001$ .

**Table 1: Mobile Phone Contamination Rates Among Healthcare Workers Across Different Work Areas**

Work Areas	Number of Mobile Phones Tested	Number of Mobile Phones Showing Contamination before Disinfection	Contamination Percentage (%)
Outpatient Department (OPD)	45	33	73.3
Central Clinical Laboratory(CCL)	36	19	52.8
Wards	26	19	73.1
Intensive Care Unit	13	8	61.5
<b>Total</b>	<b>120</b>	<b>79</b>	<b>65.8</b>

**Table 2: Microbial Contamination of Mobile Phones in Various Healthcare Work Areas\***

Work Areas	Number of Mobile Phones Showing Contamination before Disinfection	Gram Positive Bacilli (GPB)	Coagulase Negative <i>Staphylococcus</i> (CoNS)	<i>Staphylococcus aureus</i>	<i>Acinetobacter</i> species
Outpatient Department(OPD)	33	16 (48.5%)	8 (24.2%)	6 (18.2%)	4 (9.1%)
Central Clinical Laboratory (CCL)	19	11 (57.9%)	5 (26.3%)	3 (15.8%)	0 (0%)
Wards	19	6 (31.6%)	5 (26.3%)	8 (42.1%)	0 (0%)
Intensive Care Unit	8	6 (75%)	1 (12.5%)	1 (12.5%)	0 (0%)
<b>Total</b>	<b>79</b>	<b>39 (49.4%)</b>	<b>19 (24.1%)</b>	<b>18 (22.8%)</b>	<b>4 (5.1%)</b>

\*Some phones were contaminated with more than one species of bacterium.

### DISCUSSION

The present study investigated the microbial contamination on mobile phones of HCWs. Notably, 65.8% of the mobile phones showed bacterial contamination, a rate that is lower than those reported by Panchal et al [17]. Conversely, while some international studies have identified higher contamination rates, from 82.5% to 100% [18-22], others have found lower rates, ranging from 33% to 58.1%.<sup>23-26</sup> These varying rates of contamination could be due to differences in compliance with hand hygiene practices and the cleaning policies implemented across different countries [27].

The most frequently identified bacteria in the present study were Gram-positive bacilli (GPB) (49.4%), which was notably higher than those reported by Mohamedin et al (16.9%) [28]; indicating the widespread nature of GPB, which readily colonize various environments. Coagulase-Negative *Staphylococci* (CoNS) were isolated in 24.1% cases, lower than those reported by Pal et al. (31.11%) [28, 29]. CoNS are typical resident flora of the skin and have been increasingly associated with hospital-acquired infections globally [30, 31]. Similarly, *Staphylococcus aureus* was identified in 22.8% of cases, higher than those reported by Momani et al. (12.7%) and Bodena et al. (14.4%) [23, 27]. *Staphylococcus aureus* is commonly found in the skin and nasal passages of about 25% of healthy individuals [30] and is known for causing infections ranging from superficial skin conditions to systemic issues like pneumonia [31]. Compared to other Gram-negative bacteria such as *Escherichia coli* and *Klebsiella* species, the present study isolated only *Acinetobacter* species (5.1%). It is consistent with findings from other studies with *Acinetobacter* species isolation rates being 8.7% and 2.8% [32, 33]. In contrast, some studies

have highlighted the dominance of *Enterobacteriaceae*, with *E. coli* and *Klebsiella* species being the most isolated organisms [7, 27, 34-36]. This suggests that mobile phones are significant, yet often overlooked carriers of pathogenic organisms, underscoring the importance and the need of stringent mobile use practices in healthcare settings.

After the application of disinfectant wipes, swabs from mobile phones showed no bacterial growth, indicating that the wipes effectively eliminated bacteria, including alcohol-resistant Gram-positive bacilli. These results underscore the importance of implementing effective disinfection protocols for devices used by healthcare workers. The participants recognized that mobile phones in healthcare settings are potential vectors for pathogen transmission. While they agreed on the necessity for definite guidelines for mobile phone disinfection practices, no such policies currently exist. The lack of standardized disinfection procedures for mobile phones leaves this critical area of infection control unaddressed. Therefore, establishing these guidelines would help mitigate contamination risks and ensure patient safety by maintaining the highest standards of cleanliness.

This study has few limitations. First, the study has a small sample size. Moreover, the study did not examine other potential pathogens common in hospital settings, such as anaerobic bacteria, viruses, and fungi, which are particularly significant in immunocompromised individuals.

## ANNEXURE 1

### Questionnaire

**Question 1-** Which of the following best describes the mode of communication you use during your work shift in the hospital?

- a) Mobile phone with small screen
- b) Smartphone with large screen
- c) Hospital intercom
- d) Walkie- talkie

**Question 2-** Do you consider your mobile/smartphone an essential tool while at work?

- a) Yes
- b) No

**Question 3-** How often do you use your mobile phone during work hours?

- a) Frequently
- b) Occasionally
- c) Rarely
- d) Never

**Question 4-** What type of screen protector does your device have?

- a) Plastic
- b) Tempered glass - 114
- c) Others
- d) Does not have a screen protector - 6

**Question 5-** Do you follow any guidelines or rules for mobile phones usage within the work area?

- a) Yes
- b) No

**Question 6-** Do you think mobile phones harbour microorganisms and are source for nosocomial infection?

- a) Yes
- b) No

**Question 7-** Do you clean and disinfect your phone regularly? If yes, how often do you do it?

- a) Every time I touch phone after touching patients
- b) Multiple times a day
- c) Daily after going back home
- d) Weekly once/ or on holiday
- e) Rarely
- f) Never

**Question 8-** What do you use to clean/ disinfect your phone?

- a) A dry lint cloth
- b) A disinfectant spray
- c) Alcohol- based disinfectant wipes
- d) Soap and water
- e) UV- C light device
- f) Others- wet tissues

**Question 9-** Are you aware of any guidelines/ recommendations for cleaning and disinfecting personal devices like mobile phones?

- a) Yes
- b) No

**Question 10-** Do you feel it is necessary to have hospital policies or guidelines on mobile phones use during work hours in hospitals?

- a) Yes
- b) No

### CONCLUSION

This study highlights the significant prevalence of bacterial contamination on mobile phones used by healthcare workers (HCWs) in various clinical settings. The study also confirmed the effectiveness of disinfectant wipes in eliminating bacterial contamination. The findings underscore the urgent need for standardized guidelines and policies for mobile phone disinfection practices in healthcare settings to reduce contamination risks and enhance patients safety.

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